

Applying a Systematic Review to Land Use Land Cover Change in Northern Upland Vietnam: The Missing Case of the Borderlands

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Abstract

As Vietnam embraces the market economy, and a number of state policies promote reforestation and rural market integration, land use and land cover (LULC) changes are occurring in the country's northern uplands in increasingly complex and fragmented ways. Yet understandings of the degree and consequences of LULC changes in this diverse agro-ecological region are incomplete. We conduct a systematic literature review of research reported in academic articles tracing and analysing LULC change in Vietnam's northern regions. We find that these studies have tended to take place away from the most mountainous, northern borderlands. The studies nonetheless highlight a diversity of land use land cover changes caused by numerous causes, making the distinction of overall trends difficult. To complement and extend this body of research, we introduce recent LULC change research we have completed in the mountainous border districts of Lào Cai province, on the Sino-Vietnamese border. The heterogeneity of causes of LULC change in both the review articles and our case study points to the importance of adapting land use policies to local agro-ecological and socioeconomic conditions and ethnic diversity, taking into account state-farmer relations, household livelihood decision-making, and policy implementation at the commune and district levels.

KEY WORDS land use land cover; northern and border upland Vietnam; systematic literature review

Introduction

Land use and land cover (LULC) changes, including the expansion of agriculture, urbanisation, and deforestation, are occurring at an unprecedented pace across the globe. These changes have direct impacts on the environment, including soil, water, and air quality. They also directly or indirectly affect human welfare through food provisioning and disease susceptibility (Foley *et al.*, 2005; Jakobsen *et al.*, 2007; Vanwambeke *et al.*, 2007). Since the early 1990s, LULC changes have gained significant attention from researchers and funding institutions seeking to quantify these changes and understand their underlying mechanisms (Gutman, 2004; National Research Council, 2005). Consequently, there is an important body of LULC change research conducted in a number of

geographic regions and socio-political contexts, including Southeast Asia, the focus of this study (Walsh *et al.*, 2001; Samek *et al.*, 2004; Fox and Vogler, 2005; Cassidy *et al.*, 2010).

This growing literature highlights the complexity of biophysical and anthropogenic factors underpinning LULC change, and their interactions at different spatial and temporal scales (cf. Cassidy et al., 2010: López-Carr et al., 2012). Of note here are the roles of socio-economic, political, or ecological causes of land change (Geist and Lambin, 2002). Given such complexity, there is a pressing need to improve our understandings of how and why potential factors underpin changes in LULC (Gutman, 2004; Turner II et al., 2007). Not only do we need to better understand how, for instance, specific land policies and market-led transformations drive LULC change, but also how depleted soil nutrients, population growth, or cultural knowledge can trigger changes in land use (Lambin and Meyfroidt, 2010).

To take one case, in the northern Vietnam uplands, over six million ethnic minority individuals (GSO, 2010) are coming face to face with modernisation and global market integration. Tens of thousands of these individuals, many belonging to geographically dispersed, politically fragmented, and lineage-based populations, are attempting to build and maintain sustainable rural livelihoods to the best of their ability. They build on traditional ecological knowledge of food systems and local agricultural limits while encountering, adapting to, and often adopting state-sponsored agricultural programmes and market integration incentives. This integration includes strong state support for newly introduced hybrid seeds, cash crops, and a push to make swidden agriculturalists into sedentary farmers (Turner, 2012b). Increasing food security concerns, in conjunction with LULC changes and rising numbers of extreme weather events, also impact daily on the local dynamics of food systems for thousands of individuals.

We have glimpses of the degree and consequences of LULC change in these uplands, yet these tend to be incomplete, based on case studies in the region. For instance, in Hòa Bình province, annual cash-crop cultivation by Mường ethnic minority farmers and a few Kinh (lowland Vietnamese or Việt) migrant farmers was phased out during the mid-1990s to 2003, with farmers reforesting instead (Clement and Amezaga, 2008). While this coincided with national reforestation policies, the authors found that oftentimes farmers made this decision due to other factors, such as observed declines in soil fertility, and the end of informal governance over land use (Clement and Amezaga, 2008). Similarly, in Bắc Kan province, swidden cultivation has declined significantly since the introduction of forestland allocation (Castella et al., 2006). Land and migration restrictions to other communes or districts in the province have inhibited the cultivation of new fields, placing pressure on existing swidden fields. Low yields and high food deficits have placed many farmers in a state of crisis leading to an intensification of paddy land cultivation and the spread of cash crops including cinnamon, star anise, and fruit tree plantations.

Despite such nuanced analyses of LULC changes, our ability to evaluate such findings further and to monitor LULC change at a broader scale is limited by both an absence of comparative studies across the region, and a lack of methodical indicators with which to evaluate completed case studies. There are statistics for reforestation provided by official and research institutions in Vietnam, yet these are highly divergent (Meyfroidt and Lambin, 2008). Thus, we have no reliable picture of the regional impacts of LULC change in these uplands, and how and why these changes are occurring. Moreover, studies of LULC in the most mountainous border regions are scant.

Without a systematic review of research completed in these uplands, both in the mountainous borderlands and at comparatively lower altitudes. it is understandable that provincial and national government agencies may be hesitant to invest in redesigning current policies or advancing new approaches to upland land management. It is also conceivable that results from one specific human and physical geographic area are being used for policy design elsewhere, while the underlying LULC changes and causes could be considerably different, leading to inappropriate policy design. As such, the aim of this paper is twofold. First, we attempt to examine LULC change and its proximate and underlying causes across the northern Vietnam uplands drawing from a systematic literature review. Second, having found studies located in the northern borderlands nearly absent from this review, we add insight with a case study of LULC change in the mountainous border province of Lào Cai. To meet our aim, next we outline a conceptual framework to examine LULC change in developing countries. We then introduce the Vietnam context focusing on both ethnic minority livelihoods in northern Vietnam's uplands, and government policies that directly impact these livelihoods and land use decision-making. We detail the methods and results of a systematic literature review of 17 articles on LULC in upland northern Vietnam, before comparing these findings with our own results from the border province of Lào Cai.

Conceptualising LULC change and its causes As an emerging interdisciplinary approach, Land Change Science studies 'the nature of land use and land cover, their change over space and time, and the social, economic, cultural, political, decision-making, and ecological processes that produce those patterns and changes' (Aspinall and Hill, 2008, 3). We define land *cover* change as any alteration in vegetation, water, or soil cover, and land *use* change as an adjustment in human activity, for instance changes in agriculture, pasture, or urban development over the study period (Ellis, 2010). Together, the most common types of LULC change are deforestation and/or reforestation, agricultural expansion, and urbanisation (Geist and Lambin, 2002; Ellis, 2010; Lambin and Meyfroidt, 2010).

Causes of LULC can be separated into predisposing environmental factors, underlying forces. and proximate causes (Geist and Lambin, 2002). Predisposing environmental factors include elevation, slope, soil conditions, and natural disasters. Underlying causes of LULC change are commonly divided into five groups: population. economic change, policy, ethno-cultural aspects, and technology (Geist and Lambin, 2002). Proximate causes are activities that directly alter land use. One common proximate cause of deforestation is agricultural expansion which could be a result of an underlying cause such as population growth or in-migration (López-Carr et al., 2012). A summary of this framework is provided in Figure 1. Most studies of LULC change, including those reviewed in this paper, use a distinction between environmental factors, proximate forces, and underlying forces, because it is straightforward to operationalise. We thus draw on this approach to examine causes addressed in the selected papers in our systematic review.



Figure 1 Causes of LULC change, adapted from Geist and Lambin's framework of the causes of tropical deforestation (Geist and Lambin, 2002, 144).

However, it should be noted that terminology varies among authors. Proximate causes are not always explicitly identified as such; and underlying causes are sometimes mentioned as causes, predictors, or correlates of LULC change. Predisposing environmental factors are sometimes called 'biophysical causes' or 'biophysical predictors'.¹

Contextualising ethnic minorities and LULC in upland Vietnam

The focus for this systematic review and case study is upland northern Vietnam. The Socialist Republic of Vietnam officially recognises 54 ethnic groups, including the lowland Vietnamese (Kinh). Fifty-three 'minority nationalities' (các dân tộc thiểu số) total 14.8% of the country's population (GSO, 2010). In upland northern Vietnam (Figure 2) - officially labelled 'the Northern midlands and mountains' (Trung du và miền núi phía Bắc) in the 2009 Vietnam census – the total population is just over 11.05 million, with 55% (6.04 million) being ethnic minorities. This upland region (as we will call it) is predominantly over 500 m in elevation and includes 14 provinces: Hà Giang, Cao Bằng, Bắc Kan, Tuyên Quang, Lào Cai, Điện Biên, Lai Châu, Yên Bái, Hoà Bình, Thái Nguyên, Sơn La, Lang Sơn, Bắc Giang, and Phú Tho. Of these, topographic maps show that Lai Châu, Lào Cai, and Yên Bái reach the highest elevations (3142 m in Lào Cai), forming the southern tip of the Ailao Shan range, which extends from the Himalayas, and becomes known in Vietnam as Hoàng Liên Sơn mountain range.

For rural livelihoods in these upland provinces, land access and quality play central roles (Corlin, 2004; World Bank, 2009). In the 1960s, agricultural collectivisation led to the introduction of a range of homogeneous, high-impact agriculture systems in this region, most commonly at the lower altitude midlands (Castella *et al.*, 2005a). In the most northern mountainous borderland provinces, collectivisation did not occur to the same degree, due to the relative remoteness of these provinces and a lack of willingness among lowland officials to be posted there to monitor agricultural reforms (Turner, 2010).

Starting in the mid-1980s, the government initiated a series of economic reforms ($D \delta i m \delta i$) aimed at stimulating economic growth and moving Vietnam towards a regulated market economy. These shifts have included the implementation of a range of policies affecting land use systems either directly or indirectly (Fatoux *et al.*, 2002, Castella *et al.*, 2005b, Jakobsen, 2006; Turner, 2012a). A transition from subsistence crops to cash crops has been driven by changing land laws and the expansion of the market economy (Castella *et al.*, 2005b, Leisz, 2009), as well as the introduction of hybrid rice



Figure 2 Our systematic review selection steps.

and maize seeds since the late 1990s (Bonnin and Turner, 2012). New factors are further impacting the livelihoods of these communities, such as increasing weather extremes (Turner, 2010; Delisle, 2014). Whereas agricultural land traditionally grew maize as well as irrigated and dry rice for subsistence use, nowadays hybrid rice and maize are being steadfastly promoted by the state, while cash crops such as tea are expanding and rubber as a commercial crop is being introduced to specific areas (Li and Fox, 2012).

Forests augment these livelihoods by providing local populations with fuel wood and nontimber forest products (NTFPs) such as cardamom, bamboo, honey, and herbs. In 1954, the northern Democratic Republic of Vietnam (DRV) designated all hills and mountains with slopes over 25 degrees as forestlands, while State Forest Enterprises (SFEs) were formed to function as state-owned logging companies (McElwee, 2009). These SFEs have had complicated roles, logging forests in some regions, while being involved in reforestation efforts in others. Yet by 1985, forest cover for the country as a whole had dropped to 30% due to the impacts of SFEs and individual farmers (McElwee, 2004). After the initiation of *Dôi mới* in 1986, forest protection and reforestation were placed high on the state agenda (e.g. the 1991 Act on Forest Protection and Development; the 2004 Forest Protection and Development Law). A new management system was implemented, creating three classifications of forests: production forests (for the extraction of timber): protection forests (especially around watersheds); and special-use forests (those needing strict preservation for biodiversity and cultural values) (Clement and Amezaga, 2009). These classifications were upheld by the 1993 Land Law which created land tenure certificates providing production forest or protection forest allocations to households, while also specifving the extent of agriculture, timber felling, and NTFP collection allowed in forests (Morrison and Dubois, 1998; Castella et al., 2006).

Alongside bans on opium in 1993 and logging in 1997, reforestation has been steadily promoted through the 'Greening the Barren Hills Program' from 1992 (also named Program 327) and a similar Program 556 from 1995 (Meyfroidt and Lambin, 2008; Clement and Amezaga, 2009; McElwee, 2009; Sikor and Nguyen, 2011). As well as reforestation activities, Programs 327 and 556 allocated 40% and 12% of their budgets, respectively, in interest-free loans to households to assist with conversions away from swidden agriculture (Morrison and Dubois, 1998). Nonetheless, notwithstanding a budget of US\$230 million, both programmes have been criticised for failing to meet their goals of reforestation and livelihood improvements (Ohlsson *et al.*, 2005).

Following these initiatives, in 1998, the Five Million Hectare Reforestation Program (5MHF, also named Program 661) was launched with a budget of US\$2.68 billion dollars. The goal was to increase Vietnam's forest cover to 43% by the end of the programme in 2010. This was to be achieved via three million hectares planted as production forest and two million hectares as protection forest (Ohlsson *et al.*, 2005). Despite such ambitious programmes, research to date suggests that both forest density and quality are decreasing (Meyfroidt and Lambin, 2008; McElwee, 2009). How this is playing out in the northern uplands is analysed next.

Systematic literature review of LULC changes

We have adapted a systematic literature review approach to investigate LULC changes in the northern Vietnamese uplands (cf. Petticrew and Roberts, 2008; Chonody and Smith, 2013). Commonly used in the medical field, systematic literature reviews are increasingly being introduced into the social science context, allowing researchers to identify common themes or trends using both quantitative and qualitative assessment tools. These tools include a predefined set of questions and inclusion criteria, fully documented in an attempt to eliminate bias and ensure comprehensiveness.

Methods

We conducted our systematic literature review using three commonly used and endorsed academic databases: Science Direct, Scopus, and Web of Knowledge, to cover a broad range of scientific and social science journals. The review used all possible combinations of three search term groups representing location, ethnicity, and LULC. Group one contained one term, Vietnam, while group two included indigenous, ethnic minorit*, minority nationalit*, Montagnard, and hill tribe². Group three included the hyphenated and non-hyphenated terms land use and land cover. We limited the article selection to peerreview articles published in English³ and covered 1 January 1980 to 1 January 2014. A complete list of articles was exported to Endnote citation manager software (Thomson Reuters, Philadelphia, PA, USA), and after all duplicates were removed, a total of 1965 preliminary articles remained (Figure 2).

We examined these 1965 articles based on a series of inclusion and exclusion criteria applied to each article title and abstract. The principal requirements for inclusion were a study site in northern upland Vietnam (defined above) and a primary or secondary focus on types and causes of LULC change. Regional and national-based articles were examined to see if they included case studies in the northern uplands of Vietnam. Based on these criteria, 1948 articles were excluded (cross-checked by the authors). These steps (Figure 2) resulted in a total of 17 articles being selected for detailed review, published between 2001 and 2013 (Table 1). Across this time period, we see that output remained fairly consistent, with a slight increase in 2013 (Figure 3).

Table 1 Information and site location of the 17 reviewed studies (full citations in reference list).

| No. | Main author, article title and journal | Site location |
|-----|--|----------------------------------|
| 1 | Castella <i>et al.</i> 2006. Impact of forestland allocation on land use in a mountainous province of Vietnam. <i>Land Use Policy</i> . | Bắc Kạn |
| 2 | Castella <i>et al.</i> 2005b. Centralized planning and economic reforms in a mountainous region of Vietnam. <i>Journal of Contemporary Asia.</i> | |
| 3 | Castella <i>et al.</i> 2005a. Analysis of village accessibility and its impact on land use dynamics in a mountainous province of northern Vietnam. <i>Applied Geography.</i> | |
| 4 | Clement, F., Amezaga, J.M., 2008. Linking reforestation policies with land use change in northern Vietnam: why local factors matter. <i>Geoforum</i> . | Hòa Bình |
| 5 | Clement, F., Amezaga, J.M., 2009. Afforestation and forestry land allocation in northern Vietnam: analysing the gap between policy intentions and outcomes. <i>Land Use Policy</i> . | Sơ'n La, Yên Bái, Thái Nguyên |
| 6 | Clement <i>et al.</i> 2009. Drivers of afforestation in Northern Vietnam: assessing local variations using geographically weighted regression. <i>Applied Geography</i> . | Hòa Bình |
| 7 | Folving, R., Christensen, H., 2007. Farming system changes in the Vietnamese uplands – Using fallow length and farmers' adoption of sloping agricultural land technologies as indicators of environmental sustainability. <i>Geografisk</i> <i>Tidsskrift</i> . | So'n La |
| 8 | Jadin <i>et al.</i> 2013. Drivers of forest cover dynamics in smallholder farming systems: the case of northwestern Vietnam. <i>Ambio</i> . | Lào Cai |
| 9 | Lippe <i>et al.</i> 2011. Building on qualitative datasets and participatory processes to simulate land use change in a mountain watershed of Northwest Vietnam. <i>Environmental Modelling & Software.</i> | So'n La |
| 10 | Meyfroidt, P., 2013. Environmental cognitions, land change and social-ecological feedbacks: local case studies of forest transition in Vietnam. <i>Human Ecology</i> . | So'n La |
| 11 | Nguyen <i>et al.</i> 2004. Recent changes in the composite swidden farming system of a Da Bac Tay ethnic minority community in Vietnam's northern mountain region. <i>Southeast Asian Studies</i> . | Hòa Bình |
| 12 | Nguyen <i>et al.</i> 2010. Land privatization and afforestation incentive of rural farms in the Northern Uplands of Vietnam. <i>Forest Policy and Economics</i> . | (site not mentioned) |
| 13 | Sikor, T., 2001. The allocation of forestry land in Vietnam: did it cause the expansion of forests in the northwest? <i>Forest Policy and Economics</i> . | So'n La |
| 14 | Sikor, T., Truong, D.M., 2002. Agricultural policy and land use changes in a Black Thai commune of Northern Vietnam, 1952–1997. <i>Mountain Research</i> <i>and Development</i> . | |
| 15 | Tachibana <i>et al.</i> 2001. Agricultural intensification versus extensification: a case study of deforestation in the northern-hill region of Vietnam. <i>Journal of</i> <i>Environmental Economics and Management.</i> | Thái Nguyên, Sơn La |
| 16 | Vu <i>et al.</i> 2013. Land transitions in northwest Vietnam: an integrated analysis of biophysical and socio-cultural factors. <i>Human Ecology</i> . | So'n La |
| 17 | Wezel <i>et al.</i> 2002. Temporal changes of resource use, soil fertility and economic situation in upland Northwest Vietnam. <i>Land Degradation and Development</i> . | So'n La |

Site locations are presented in Figure 4.



Figure 3 Year of publication of the 17 articles.

An in-depth questionnaire was designed and completed for the 17 articles to identify key trends in LULC change in the region. The questionnaire (Appendix S1) included both binary questions and open, qualitative questions. First, basic information regarding title, authorship, date, time frame, scale, and type of article was collected. Then socio-economic information, types of land use, and/or land cover considered, actual changes in LULC, and environmental factors and/or underlying causes of change were collected. The data were recorded in Excel (Microsoft, Redmond, WA, USA) and analysed using basic statistics.

Systematic literature review results

Spatial and temporal scope

It is immediately clear from a visual representation of these studies (Figure 4) that the majority of LULC change studies in northern upland Vietnam have been completed in non-borderland regions, with an important concentration of LULC change studies in two provinces: Son La and Bắc Kan. In Bắc Kan, three of these studies had the same lead author (Castella nos. 1-3), while the others were more diverse. Authors noted that the locations for their studies were chosen based on characteristics such as remoteness, poverty level, implementation of a specific policy, or supposed representativeness for northern Vietnam (nos. 1, 4, 5, 7, 10 in Table 1). Areas were also chosen due to ethnicity, such as the presence of Black Thái (nos. 13, 17) or the diversity of ethnic groups and hence assumed diversity of livelihoods (nos. 8, 16). Physical and political access to the field was another reason for case study choice (nos. 5, 15); not surprising given the difficulties for overseas researchers to access remote rural fieldwork sites in a socialist state (cf. Turner, 2013). We suggest that this last point is a fundamental cause of the paucity of research case studies in the upland borderlands to date. The numerous official permissions required to complete fieldwork in borderland provinces, as well as the mountainous terrain and lack of infrastructure. makes working there time consuming and arduous. The only borderland province where access has become slightly easier to negotiate in the past ten years is Lào Cai province (no. 8) due to a regular and growing influx of international tourists and infrastructural development.

The sampling scales of the studies ranged from the household to the provincial, with state categorisations (household, commune, district, province) being most commonly used as scale representations (Figure 5), with the exception of one paper (no. 17) discussing ethnic territory. Four studies (nos. 2, 5, 12, 17) analysed change at more than one scale. For instance, Castella et al. (2005b; no. 2) analysed road accessibility at both the district and provincial levels. Eight studies included data at the 'village level', yet none defined this, a somewhat problematic stance as 'village' is neither a census classification in Vietnam nor a commonly used term by the state, which prefers the hierarchical classification of province (tinh), district (huvên), commune $(x\tilde{a})$, and hamlet $(th\hat{o}n)$. We presume that authors take a 'village' to be a state-defined hamlet, but we cannot be sure.

Temporally, the majority of articles concentrated on the period after $D\hat{o}i m \dot{\sigma}i$ (Figure 6), with only four taking a longitudinal approach starting at the end of French colonial rule in 1954.

Ethnicity

The majority of studies (82%) included information on the ethnic groups residing within the study area (Figure 7). The dominant ethnic group was the Thái, with Tày, Dao (Yao), and H'Mông (Hmong) groups frequently noted, coinciding directly with the dominant population numbers in the provinces and districts studied. Inclusion of the Kinh majority occurred in several articles, although no study considered only Kinh inhabitants.

Land cover changes

Three major land cover changes were addressed in the 17 studies. First, regarding forest cover,



Figure 4 Northern upland Vietnam: the location of the 17 reviewed studies and our border case study in Lào Cai province (no. 18). Articles that cover district and provincial scales have a marker placed in the centre of the study area (site location of no. 12 was not mentioned in the article, no. 14 has the same location as no. 13).



Figure 5 Scales at which case studies were undertaken.

88% (15 studies) noted increases in forest cover. Analysed by different forest types, six articles mentioned closed canopy forest, and of these, four recorded increases. For open canopy, both an increase and decline of cover was noted equally by two studies out of the five studies mentioning this class. Five studies considered fruit trees, noting an increase in three studies.



Figure 6 Time frame of the 17 studies in review and our border case study in Lào Cai (dotted line: 1986 - introduction of $D \delta i m \delta i$ economic renovation).

Nine of these 15 studies specifically considered tree plantations (Figure 8), and in six of these studies, there was an increase in cover.

Second, turning to agriculture, both directions of change were observed. Of the 14 studies that considered agriculture, 93% (13) noted



Figure 7 Ethnic groups focused upon or mentioned in articles.



Figure 8 Distribution of different forest classes mentioned in articles.



■ Considered NIncrease ■ Decrease

Figure 9 Distribution of different agricultural classes mentioned in articles.

an increase in an agricultural class, while 79% (11) documented a decline (Figure 9). Of the 13 studies that considered upland crops (defined here as maize and cassava), 85% (11/13) reported an increase in area, while 46% (6/13) noted a decline. Similarly, of the studies that mentioned paddy land (terraced rice fields), 69% (9/13) noted an increase while 15% recorded a decrease. The largest agricultural decrease



Figure 10 Distribution of other LULC classes mentioned in articles.

occurred for swidden, with a 67% decline (8/12), and only a 33% increase (4/12) – albeit, given state policies strongly opposing swiddening, even this increase is intriguing. Similarly, there was a 60% decline in upland rice (defined as dry, hill rice) (6/10) and only a 20% increase. Of the three studies that mentioned cash crops, two noted an increase and one a decrease.

Finally, 76% (13) of the studies mentioned changes in other LULC classes (Figure 10). Of these, 11 discussed shrubs, with 45% indicating an increase, while the rest noted a decline. Of the four that discussed bare land, half recorded an increase. Three studies mentioned grassland, all of which noted a decline; while one study mentioned an increase in urban coverage. While not a land use class, interestingly 46% (six) also discussed livestock, with two-thirds of these recording an increase, and the other third, a decrease.

In sum, for each LULC type, the fact that both increasing and decreasing change was recorded suggests that highly complex and diversified processes have occurred in the region. The most important and most common LULC changes (over 50% of the studies) are increases in forest cover (the highest of which was a 75% net increase in Bác Kan province, no. 3) and agricultural area, specifically upland crops (maize and cassava) and paddy land. In the next section, we examine the underlying causes of such patterns of LULC change in the 17 studies.

Causes of LULC change

To examine causes, the articles used a combination of quantitative data collection, such as



Figure 11 Predisposing environmental factors (above dotted line) and underlying causes of LULC change mentioned in the articles.

remote sensing, surveys, and census information, sometimes also adding qualitative data collected via interviews and reviews of the existing literature. Six articles used a regression-based analysis to determine significant causes of LULC change.

Environmental factors and underlying causes of LULC change noted in the 17 studies are summarised in Figure 11. The most frequently cited environmental factor was soil degradation (47%, eight studies), while six studies (35%) cited slope (nos. 1, 3, 6, 7, 8, 16) and one study cited elevation (no. 17).

Underlying demographic causes such as population change and/or migration were mentioned in 35% (six) of the articles (nos. 1, 2, 7, 10, 11, 13). Of underlying economic causes, the most frequently cited was market integration, including access to markets (76%, 13 studies) and roads (35%, six studies). Studies reported that farmers with the ability to sell agricultural surplus were more inclined to change their agricultural approach to either more intensive or extensive agricultural production. Other cited underlying economic causes of LULC change were access to land (53%) and economic incentives and asset availability (30%). Ethno-cultural underlying causes of LULC change included cultural knowledge, awareness, and preference (41%, seven studies).

Finally, policy implementation in the uplands is one of the most common underlying causes (82% of studies) of LULC change, with 11 different policies or programmes noted (Figure 12). The most often cited was Program 327 (59%, 10 studies), which, as noted earlier, involved reforestation activities and provided interest-free loans to households to assist with conversions away from swidden agriculture. This was followed in importance by the 1993 Land Law (47%, eight studies). Other policies cited include Resolution 10, $D \delta i m \delta i$, the 1991 Act on Forest Protection and Development, Program 661, the United Nations World Food Programme, changes in the cooperative system, and the 1997 logging ban.

Teasing these policies apart, there is a high variability of sub-causes, including economic incentives to convert swidden to paddy land; to apply fertilisers to hybrid crops; and to encourage off-farm jobs, access to credit, and compensation through governmental programmes for reforestation or agriculture. Furthermore, it is important to note that one cause may have different effects on LULC in the same study region, as explained in six articles (nos. 1, 2, 7, 8, 10, 16).

This brief analysis points to the extreme complexity of LULC change in the northern uplands (away from the borders) and the broad range of proximate and underlying causes. As such, it is difficult to make any overall interpretations concerning LULC dynamics and causes across this region as a whole, beyond noting that state policy appears to have important impacts on how farmers decide to use their land. Physical and political difficulties in accessing information on the ground, including micro-level statistics, and qualitative studies, add to the lack of analysis available across these uplands. As such, it is impossible to draw these rather disparate cases together to form one meso-level scalar study, as one might hope to do. At this point, we thus want to complement these studies and add to contemporary understandings of LULC in these uplands by 'filling a gap'; namely, by comparing results from a LULC study we have completed in the borderland districts of Lào Cai province. This adds to our regional understandings by providing a study from the most mountainous uplands, and including a focus on the possible impacts that a political borderland can have.

Adding an upland borderland case study

Drawing from this systematic review, we wanted to know: Will state policy be any more or less important to LULC change in a highly mountainous province? Does the Sino-Vietnamese borderline impact LULC change in specific ways? And what are the similarities and differences regarding LULC change in Lào Cai province compared with the 17 other case studies? Our case study



Figure 12 Number of articles discussing different policy causes of LULC change.

focuses on the four districts and one city municipality of Lào Cai Province that all border Yunnan Province, China, namely Bát Xát, Bảo Thắng, Mường Khưởng, and Si Ma Cai districts, and the city municipality of Lào Cai (Figure 13). In 2009, the total population of these five administrative units was 405 411, just over half the province's total population of 614 000 (GSO, 2010). Ethnic minorities comprise 62% of the population of the study area (Rural Land Survey, 2006). Our aim was to map LULC in 1999 and 2009, as shown in Figure 14,⁴ as well as to better understand LULC change and its underlying causes through interviews and observations.

Comparing our Lào Cai results with the results of the systematic literature review, ours is the most northern study, in highly mountainous terrain, and the only one concentrating on borderland districts. With a focus on current trends, our study also covered a more recent period than those already published. Regarding ethnicity, the districts in our study have a higher proportion of minority groups than the average of the northern uplands of Vietnam (62% against 55%), with our study noting Hmong and Yao ethnic minority groups specifically as those commonly involved with non-timber forest product cultivation and forest management.

In terms of LULC change, we found an increase in forest cover (both in closed canopy

and open canopy forests), which was also observed in the 17 studies. However, causes of such increases in our case differed between lower-altitude (predominantly Kinh-populated) areas, and high-altitude areas (predominately ethnic minority populated), due to the variable geographic conditions of our case, discussed below. With regard to agriculture, we observed a slight decline in paddy fields (in contrast to the 17 studies) which is mostly due to road expansion, and occurred in upland and steep fields (corresponding with the 17 studies). Turning to other LULC, the urban expansion currently under way in Lào Cai, was only recorded in one of the other 17 studies (no. 11, in Hòa Bình province).

Figure 15 summarises environmental factors, and proximate and underlying causes of LULC change in Lào Cai's border districts. Proximate causes included three groups: (1) timber extraction and reforestation plantations; (2) urbanisation along with infrastructural expansion; and (3) agricultural changes. Underlying causes of timber extraction and reforestation plantations include rather conflicting policies regarding timber extraction via state and private enterprises, reforestation programmes, local ethnic minorities' NTFP cultivation and sale (e.g. cardamom), and in-migration of mostly Kinh migrants (for work in state and private forest



Figure 13 Location of the border districts in Lào Cai.

enterprises). Urbanisation has been encouraged by pro-urban policies, market integration, and in this specific case, trans-national policies. Agricultural changes have in turn been influenced by market integration, agricultural policies (e.g. hybrid seed promotion), population growth, and specific cultural knowledge regarding livelihoods.

Our analysis focused on better understanding the underlying causes of the two main LULC changes we found in this region: forest increase (in both high-altitude and low-altitude areas) and urban expansion (Trincsi *et al.*, 2014).⁵ With regard to increasing forest in high-altitude areas, our interviews revealed three policies and processes as causes. First, state-sponsored programmes promoting hybrid rice and maize have caused some farmers (who are mostly ethnic minorities) to switch to more intensive rice farming techniques, at times reducing their agricultural footprint and hence increasing forest cover, especially in high-altitude areas. Perhaps more importantly though, a central implication of hybrid agriculture is the need of cash for agricultural inputs which has resulted in expanded cash-creating activities, such as cultivating cardamom under the shade of mature forests (Turner, 2012a). In Bát Xát district for instance, we found this cultivation to be one of the few means by which ethnic minority farmers gain cash income. Second, relaxed cross-border trade regulations with China have encouraged local farmers to plant cardamom for export. Third, interviews with commune officials in 2014 point to reforestation programmes, such as Programs 327 and 661, as succeeding in convincing some households to protect forest in high-altitude areas (for example in Mu'ờng Khu'ơng and Si Ma Cai),



1999 Land use land cover map

Figure 14 Land use land cover maps of the border case in 1999 and 2009.

albeit with very variable degrees of success across lower altitude areas.

In contrast, in the lower altitudes within our case study, interviews and observations revealed that the increase of forest was mainly due to increased plantations, especially in the east of Båo Thắng and south west of Lào Cai city. Improved access to roads and the Chinese border were

reasons cited for the higher integration of timber enterprises and local farmers turning to the market economy for forestry. The majority of state and private timber enterprises are run by lowland Kinh who have migrated to the region since the 1960s (Sikor, 1998; Hardy, 2000; McElwee, 2009).

An increasingly extensive and upgraded road network across Lào Cai helps in part to explain



Figure 15 Summary of causes of LULC in the northern border upland of Vietnam.

the intensive urban expansion, along with improved access to local and Chinese markets. Road and other infrastructure development is framed by national pro-urban policies since Dôi mới, while the growth of rural small cities has been encouraged since the country's Master Plan of 1998 (Coulthart et al., 2006) and the 2013 provincial report, 'Urban center planning of Lào Cai to 2020' (People's Committee of Lào Cai, 2013). At a broader scale again, urbanisation is linked to regional plans to facilitate cross-border trade and promote the Greater Mekong Subregion North-South corridor. Migration to Lào Cai also contributes to urbanisation, due to increasing business and service opportunities in the border city and nearby towns. Currently, Lào Cai has one of the highest in-migration rates of the northern midlands and mountains of Vietnam (GSO, 2011). In sum, LULC changes in the border districts of Lào Cai province are extremely heterogeneous, as also found across the 17 case studies of the systematic literature review. Yet our fieldwork on the ground revealed surprising underlying causes for LULC change in these borderlands such as ethnic minority reactions to policy (e.g. increased protection of forests for NTFP cultivation) and cross-border impacts on urbanisation, not necessarily repeated elsewhere in the uplands.

Conclusions

A systematic literature review allows for a comprehensive analysis of publications, while making it possible for others to replicate the approach to validate interpretations. Nonetheless, we found undertaking such a review on LULC change extremely challenging due to the diversity of disciplines that study land use (human ecology, geography, economics, computer modelling, and so on), while the methodological approaches are also diverse. Some articles are solely quantitative or qualitative, while others are both, making it difficult to compare and evaluate results. However, a systematic literature review can be useful to reveal the 'big picture' (or in our case, the absence of a big picture) of a phenomenon. From our review and our own case study, two clear results

emerged; first, there are no clear tendencies of LULC change and of proximate and underlying causes in the uplands of Vietnam; and second, the upland borderlands of Vietnam remain understudied, yet fieldwork there reveals important, dynamic causes of LULC change.

What are the policy implications of these findings? From our own research in these uplands. we find it extremely difficult to make generalisations about LULC change beyond the commune or district level, pointing to the difficulties for policy implementation in this context. The systematic review also pointed to this complexity by highlighting the lack of similarities across the region (although it is equally important that this could be related to different methodological approaches, too). While at times broad trends of LULC change, especially regarding forest cover and its causes in the uplands of Vietnam, could be deduced from the review, a closer analysis of our border case revealed that national reforestation programmes (as one of multiple variables) can have highly uneven impacts on forest cover, depending on altitude, local official attitudes, and the livelihood decision-making of both Kinh and ethnic minorities. Kinh residing at a low altitude rely more on reforestation programmes to establish production-forest, while high-altitude ethnic minorities rely more on cardamom or other NTFPs, as well as cultural understandings of watershed protection, and in turn protect specialuse forest (cf., Meyfroidt, 2013). Agrarian transformations due to new policies such as hybrid crops also have indirect effects on forests. Concurrently, intensifying market integration and urbanisation are important and cross-border trading is becoming increasingly common for both Kinh and ethnic minorities as they diversify livelihoods and have increasing cash needs for agricultural inputs. All these causes intertwine to create variable effects across the region.

During fieldwork, we found that recent policies being implemented in Lào Cai province diverged in their capacity to adapt to local conditions. For example, the New Countryside Program (*Nông thôn mới*) was put in place in 2010 to comprehensively develop infrastructure, the economy, culture, protect the environment, and improve security in the countryside. It has rigid thresholds/norms, with a list of 19 strict criteria applied at the commune level for the whole country. Yet from our interviews in 2014, it was clear that this policy had not been adapted to local conditions, it being impossible to achieve such criteria in certain high-altitude communes. For example, insisting on cultural community houses being larger than 300 m^2 , and residential houses larger than 100 m^2 is unrealistic where there is little flat land. On the other hand, the 'Replacing fields by rice' ($D \delta i n u \sigma ng l \delta y g a \sigma$) policy, within the 5MHF reforestation programme, operating in high-altitude locales in Bác Hà, Si Ma Cai, and Mu'ờng Khu'ơng districts (above 1000 m), appears to have been adapted more successfully for local conditions. Rice contributions provided by this policy let households gain food security for the years before returns from plantation timber are possible.

In sum, this paper has highlighted that any interpretations of LULC change and its causes in these northern Vietnam uplands must be careful to take a diversity of local conditions into account, including not only predisposing environmental factors but also underlying factors such as market integration, socio-economic dynamics, ethnicity, cultural knowledge, as well as policy implementation including transnational schemes. Policies designed for these uplands must be flexible and adaptable to local conditions. The challenge in the immediate future will thus be to gain greater access to this region and its populations to undertake careful on-theground fieldwork and to continue to fill spatial gaps. This, in turn, will allow for policy makers to become more aware – through careful LULC change studies such as those reviewed here - of the specific negotiations and nuances involved in state-farmer relations, and of livelihood and land-use decision making at the household, commune, and district levels.

NOTES

- Another way of distinguishing causes of LULC change is endogenous versus exogenous causes (Lambin and Meyfroidt, 2010, 108).
- This term is not commonly used among Vietnam scholars, but is still in common usage in Thailand. Hence we included it to cover authors who might have moved research site recently, or who were completing regionwide studies.
- 3. We did not cover Vietnamese language academic articles because LULC change research is extremely limited in Vietnam, seldom peer reviewed, and tends to favour state policies given the socialist context within which such academics are working (see Salemink, 2013 regarding censorship in academia in Vietnam).
- 4. Details of the methods used, classification procedures, and our specific results can be found in Trincsi *et al.* (2014).
- 5. We conducted field observations and interviews in summers of 2013 and 2014 to deduce socio-economic and policy causes. Interviews were conducted with 20 ethnic minority farmers and 15 state officials.

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Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Appendix S1 Questionnaire.